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On the Value of Possible Observations from Free Balloons.

By the Rev. J. M. Bacon.

During the past summer and autumn I have made a series of balloon ascents, seven in all, under varying conditions and at different hours of the day and night, a principal object being to gather fresh information as to states of atmosphere prevailing at different heights in our own skies, with the view of determining the likelihood of securing certain observations possessed of a new value :—

The observational work I more particularly had in view was :—

(1) To determine how much more of the solar spectrum could be photographed at a great height, more particularly its extension into the ultra-violet.

(2) To photograph the solar corona by such methods as have been adopted by Sir W. Huggins under circumstances of diminished air-glare.

(3) To undertake such visual observations as could be usefully made with low power under exceptional conditions of atmosphere.

Inasmuch as all, or nearly all, of such observations have already been undertaken from observatories standing on high elevations, it was essential to determine in what particulars the atmospheric conditions prevailing in mid-air above plain country differ from those recorded at like altitudes on mountain heights.

The difference appears of a most important nature. Abundant testimony shows that, during night hours at least, currents are constantly ascending or descending mountain slopes, and it can scarcely be doubted that the air in these regions is also seriously affected by radiation from heated rock surfaces. Moreover, I am led to suppose that, whether by reason of its attraction or other cause, a denser film of air is always and everywhere clinging to the actual surface of Earth.

The character of the late summer was doubtless somewhat exceptionally uniform, but it is noteworthy that in all daylight ascents a very obvious haze was always surmounted at heights varying from 4,000 feet to 6,000 feet, and this possessed a well-defined limit, above which the sky always became bluer in a marked degree. The colour would sometimes assume the deepest blue, though no darkening of the sky was observed.

During an ascent made on a serene and cloudless moonlight night it was found that an unsteadiness of atmosphere noticeable on the ground had entirely disappeared before 6,000 feet was reached. At this height the scintillation of the stars had become less, and the Moon shone with almost intolerable brilliance in the clearest sky. As soon, however, as the descent had been

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effected it was noticed that the Moon was surrounded by a vivid circle of iridescence, which remained unchanged during the remainder of the night.

The presence of haze was not made visible by moonlight, but by means of an extremely sensitive air thermometer I detected distinct and definite layers of air, many degrees warmer than on Earth, at different heights; and I conjectured from the fickle and otherwise unaccountable behaviour of ground echoes that these existed in detached pools rather than in extended strata.

The period of observation did not exceed two hours, but at frequent intervals the blast of a horn was blown, and its echo from Earth attentively listened for in the absolute silence prevailing, care being also taken to repeat the experiment many times to make sure of securing some good reflection of sound. These echoes would occasionally be obstinately silent at 1,000 feet, and again, during certain intervals, become easily heard at more than twice that height; and it should be mentioned that this peculiarity had never been observed during day ascents.

The travel overhead of air of the nature that this experiment indicated would sufficiently account for its unsteadiness as observed below. Moreover, a number of uniform photographic exposures made at different intervals showed that the actinic action of light, as a whole, increased with height, but varied according to localities. In a like manner, also, dust in suspension decreased generally with altitude, but also varied with locality.

I would point out that the amount of glare-causing matter (as noticed from above) existing in lower strata does not appear to depend on hygrometric conditions; and again, that when much glare is present in lower levels, the air may still be in such a condition—presumably very homogeneous and steady—as to be extraordinarily transparent to waves of sound.

In proof of this I proceed to show three series of photographs. In two of these it will be noticed that up to a height of nearly 3,000 feet the characteristic glare reflected from matter in suspension beneath is equally absent, and to a very unusual extent, yet hygrometric conditions were quite opposite in degree. In the third case, where no bright pictures could be taken, in spite of brilliant Sun, echoes off the ground were caught at a greater height than on any other occasion during the summer.

It would appear probable that those conditions, considered above, which must be inimical to good definition would be more or less apparent at all stations on the Earth's surface, whereas they, as well as a very large proportion of prevalent cloud, could be surmounted at a moderate height by an aërostatic observatory.

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